

# PLANT SANITATION IN FRUIT PLANTATIONS

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## PLANT SANITATION IN FRUIT PLANTATIONS\*.

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The ideal variety of apple or plum<sup>\*</sup> for growth on a commercial scale is one which crops heavily and regularly, is of good quality, and is resistant to disease. Unfortunately it is as rare in the case of fruit trees as in other cultivated plants, for all these desirable qualities to be combined together. Many of the best market varieties of apples and plums are subject to serious attacks of fungoid or insect pests, and it often happens that the most valuable commercial varieties are those which suffer most from disease. Indeed, certain diseases, e.g. canker in apples and silver-leaf in plums, may threaten the very extinction of some varieties grown on a large scale, unless measures are taken to control their ravages. Hence fruit growers must of necessity spend considerable time and money in combating disease unless they are prepared to see their plantations become derelict. Whenever a crop is grown on a large scale and is forced to its best efforts towards productivity, disease will frequently tend to increase beyond the normal unless drastic measures are taken to deal with it on its first appearance. If neglected, disease becomes cumulative and in its latest stages often assumes the character of an epidemic even though the particular malady is not one of an essentially epidemic nature.

Plant diseases, like human ailments, can be dealt with in various ways. The best means of dealing with disease, if one may so put it, is to avoid it altogether. With cultivated plants, this desirable end can usually only be achieved by obtaining varieties which are immune or very resistant to the most serious pests, whether insect or fungoid. Thus in apples, 'Bramley's Seedling' is very resistant to canker, and in plums 'Persnore' is almost entirely immune from silver-leaf. With certain human diseases, e.g. small-pox, an artificial immunity can be conferred by vaccination, but similar methods of establishing immunity in plants cannot yet be applied, chiefly because there is nothing comparable in plants to the blood stream in man with all its latent healing properties circulating rapidly through the body.

\* A paper read at the Eastern Counties Fruit Growers Conference, November 1919.

It often happens that varieties of cultivated plants which are specially resistant to disease are poor in quality or in cropping power. The plant pathologist and the cultivator here look for the assistance of the expert plant breeder to make the necessary desirable combinations. As is well known, this has already been done with many annual plants, especially the cereals, with great success, and one looks forward to the time when similar developments will take place with perennial plants such as fruit trees, although success in this direction will necessarily be slower. Again, it does not follow that because a plant is immune from one disease that it escapes attack from other diseases. Thus, Lord Derby apples which are resistant to ordinary canker are liable to serious damage by blossom-wilt, and Pershore plums which are practically immune from silver-leaf are often attacked by the fungus *Fomes pomaceus*—which, however, is fortunately far less destructive than *Stereum purpureum*. It is, therefore, a counsel of perfection to advocate the selection of varieties which are not affected by disease, and so means have to be devised and set in operation for attacking fungoid and insect pests as they appear.

In human illnesses, medical means are often applied to effect a cure. Thus some drug is taken, or injected into the blood, which either exerts a stimulative action enabling the body to throw off the malady, or which, by some directly poisonous effect, kills the parasitic organisms that are the cause of the disease. In plant pathology, however, medical treatment by internal application can only rarely be applied with any hope of success, chiefly, as already stated, because the higher plants possess nothing comparable to the blood stream of animals, the movements of sap in the former being essentially different from the latter. There is, however, a mode of dealing with certain insect and fungoid pests which is of the greatest importance to fruit-growers, and which can be compared in some respects to medical treatment. I refer to spraying with insecticides and fungicides—in the use of which fruit-growers, from the time when the vine-growers of France first began to use copper compounds as a means of protection, have always been the pioneers. As is well known, insecticides are usually most potent when applied just as the pest is emerging from the resting state or at any rate before the insect is abundant in an active condition, but many fungicides must be applied before the appearance of the fungus in an infectious form in order for the leaves and stems to be protected from penetration. Certain pests and diseases, such as aphid in plums and scab in apples, can be entirely, or almost entirely, controlled by spraying. It is not proposed to deal further with the subject of spraying in the present paper, except



to say in passing that much money is sometimes wasted by spraying at the wrong time.

Finally, there are the surgical and hygienic means of dealing with plant diseases. At a time when hygienic measures are assuming increasing importance in the medical profession, it is of interest to point out that these twin phases of plant sanitation have long been the mainstay of the plant pathologist, and probably will long continue to be. Fruit trees in particular lend themselves to surgical treatment when attacked by certain diseases. It is not the case here that if one member of the plant body suffers, all the other members suffer with it, for the unruly limb of a fruit tree can be severed with nothing but benefit accruing to the remainder of the tree. Fire is the strongest weapon in the armoury of the plant pathologist, and notwithstanding that its frequent use in this connection is sometimes slightly referred to as a primitive and unscientific weapon, and not at all in keeping with the elaboration of the twentieth century, it is undoubtedly the surest destroyer of disease that exists. In plant sanitation, one aims at the eradication of the sources of infection. This is a point of view which should be kept constantly in mind by the cultivator. It may be urged that it is impossible to eradicate completely the sources of infection in the case of the commonest plant diseases. Be that as it may, and certain human diseases such as yellow fever have been wiped out in parts of the tropics solely by the application of sanitary measures, conviction is firm that many of the most serious fungoid pests can be greatly reduced by destroying their breeding grounds which are still often left either within or near fruit plantations. It is a well known fact in medical science that in diseases of parasitic origin like malaria and tuberculosis the magnitude of the dose, so to speak, of the parasite frequently determines whether disease is established or not. If only a few germs are absorbed, the parasite may not be able to establish itself, while if many are taken in, disease will develop rapidly. The same factor operates with certain plant diseases, and many growers here must be familiar with plum orchards which, through neglect in the eradication of branches bearing *Stereum purpureum*—the cause of silver-leaf disease, succumbed in the later stages with amazing rapidity. In such cases, probably the most potent factor is the great abundance of spores shed by the fungus in the immediate vicinity.

The first principle of sanitation in fruit gardens is to avoid as completely as possible any harbourage for the breeding of insect and fungoid pests. This postulates the cutting off of branches which are dying back and their speedy destruction on the spot by fire, or removal from the plantation. If the severed

branches are allowed to remain in the plantation, the fungus which killed them will soon fructify and shed its spores around in the same way as if still attached to the standing tree. Large wood piles are often seen in fruit plantations forming excellent breeding grounds for such a destructive pest as *Stereum purpureum*. In these days of fuel shortage there should be no difficulty in disposing of wood cut out in this way. Not long ago I saw a gigantic pile of red currant prunings in the midst of a large area of red currants, the prunings being literally smothered with the pink fructifications of *Nectria cinnabarina*, which, as many fruit growers know to their cost, is becoming increasingly destructive to red currants. There is no reason why these prunings should not have been burnt as soon as collected. In cutting out diseased branches, action must be sufficiently drastic to ensure that the downward limit reached by the fungus is excised. This is particularly important with silver-leaf disease, the region penetrated by the fungus being marked by a brown discolouration in the wood, which is often a considerable distance below the silvered foliage. In this connection mention may be made of a case seen during the summer: the branches of certain silvered 'Lord Grosvenor' apple trees had been cut back, but not far enough, as the fungus *Stereum purpureum* was developing in quantity from each of the exposed extremities. We have not infrequently seen silvered trees the upper parts of which have been lopped and the trunks left standing and bearing enormous quantities of *Stereum*. Such a practice cannot be too strongly condemned. Where large branches are severed, the exposed surfaces should be made smooth and covered with tar to prevent the ingress of wound parasites. While on the subject of branch infection by silver-leaf, it may be mentioned that it is usually the wisest economy to cut out silvered branches as they appear, i.e. before they die back; there is then not the slightest opportunity of the fungus fructifying through delay in cutting out the dead wood.

With other diseases there is often no means of telling that a parasite has entered the tree until the branches begin to die back and fructifications of the fungus appear. This is particularly the case with the die-back of plums and cherries caused by the fungus *Cytospora leucostoma* and the affection of plums due to *Fomes pomaceus*. In such, drastic action can only be taken upon the appearance of the first external signs of disease, when the greater part of the trees can often be saved, if excision is effected judiciously. While dealing with the subject of excision, it is recommended that, in soft-wooded varieties such as the 'Victoria' plum, the branches of which frequently break through overcropping, broken limbs should be cut back flush



with a larger branch or main stem immediately after removal of the fruit. It is the ugly wounds of broken branches which offer special facilities for the entrance of wound parasites such as *Stereum purpureum*.

Where a tree is dying back to such an extent that its loss is inevitable, it is important that the stump should be removed if possible at the time of felling. Unlike the forester, the fruit grower is little troubled by the action of root parasites, but nevertheless the stumps and the larger roots should be removed in order to prevent the growth of suckers and for the future convenient working of the plantation. If the stump cannot be removed, it should be covered with soil to prevent the development of dangerous fungi such as *Stereum*. In the case of plum trees removed on account of silver-leaf disease one has always hitherto hesitated to suggest the planting of other susceptible varieties of plum on the same site, but during the past summer considerable areas have been seen in which young 'Victoria' plums have been planted where older silvered trees have been removed; these young trees have remained healthy up to the present, i.e. for a period of 2 or 3 years. Although one is not in a position at present definitely to recommend this course, there seems to be no undue risk in replanting with the same variety, if this is desirable for other reasons, and provided the stumps of the diseased trees are removed.

As time proceeds, greater care will probably be devoted to the control of such diseases as brown rot of apples and plums which in certain seasons levy a heavy toll on the fruit. In the main, this trouble is carried over from season to season by fruits which, mummified by the action of the fungus, hang upon the trees during the winter or lie on the ground. Where brown rot is liable to be severe, it would be worth while to have these mummified fruits collected and destroyed during the winter. Another closely allied disease, the blossom-wilt which Wormald has shown severely affects 'Lord Derby' apples, can be dealt with by the excision of the affected spurs. It has been demonstrated that this operation of removing the diseased spurs is commercially profitable. Again, the common scab fungus, *Fusicladium dendriticum*, usually hibernates in the young twigs of the most susceptible varieties of apples, and while pruning is being done, care should be taken that all the twigs which show small pustules in the bark should be cut off. With the common canker caused by *Nectria ditissima* it is generally recognised that this disease is chiefly dependent upon the nature of the variety and the conditions of the soil. There is evidence too that the influence of the stock is not inconsiderable in this connection. The wise fruit-grower will therefore select his varieties accordingly.

Excision of cankered areas is undoubtedly profitable in some cases, particularly in young trees, as this trouble, like most others, becomes cumulative if neglected.

Care must be taken to prevent the development of dangerous fungi not only within the plantation but also in its immediate vicinity. On more than one occasion I have seen silvered sloe trees with the fungus *Stereum purpureum* developing on the dying branches, in hedges bordering plum plantations. It is obvious that such trees should be removed, as well as any other, such as laburnum, which happen to develop silver-leaf disease. The stumps of elm trees in hedgerows are a prolific source of the same species of *Stereum* and it is known that the fungus from this source is just as dangerous in causing silver-leaf as is *Stereum* taken from a dying 'Victoria' plum. Stumps of practically all broad-leaved trees with the exception of oak are liable to give rise to profuse growths of this fungus. Such stumps should be eradicated, charred, or covered with soil if they are on the borders of fruit plantations. Fruit gardens situated in the midst of agricultural land are more favourably placed as regards danger of attack by wound parasites than are plantations near woods, in which most of these fungi find an excellent harbourage. There is no excuse, however, for such a practice as that of making fences of plum wood around fruit plantations. That is simply asking for trouble. I once saw a fence, made of plum wood, separating one plum plantation from another, which was literally covered with the fructification of *Stereum purpureum*. Can it be wondered at that silver-leaf disease was rife in both these gardens? In another place, a number of half-standard plums were tied up to stakes made of birch stems on which *Stereum* was developing in abundance.

With a few diseases such as plum rust and black currant rust, the fungus completes its life on two different kinds of plants. Thus in the plum rust, the fungus lives indefinitely in the perennial parts of the commonly cultivated Anemone, *Anemone coronaria*, in the leaves of which spores are produced in the spring, which in turn affect plum leaves. Unless, therefore, the diseased anemones are eradicated, there is no means of preventing attacks of plum rust in the immediate vicinity. Some years ago, I saw a very severe attack of plum rust in fruit orchards near a florist's garden in which diseased anemones were known to be present. So severe was the plum rust that the trees were defoliated by the end of August. More recently, the florist's garden has been converted to other purposes and plum rust has been scarcely noticeable in the vicinity. One is strongly inclined to suggest cause and effect as operating here. With black currant rust, in which the effect of a bad attack is



less noticeable, the alternate stage of the fungus grows upon Weymouth pines, which it gravely injures. Here again diseased Weymouth pines should not be allowed to occur in the neighbourhood of fruit gardens. If a comprehensive system of inspection of plant diseases is ever instituted in this country, these are two of the diseases which will have to be kept under observation, for although they are not at present a menace to the fruit-grower, they have dangerous potentialities.

The remarks just made with reference to market plantations apply with even more force to nursery gardens. The nursery is the foundation of all sound fruit growing, and this country is fortunate in possessing many firms of nurserymen who have the highest possible sense of responsibility to their customers. If one imagines what might have been distributed by way of disease and by poor quality stocks by untrustworthy people, the effective manner in which the nurseries have firmly established the market fruit-growing industry in this country will be at once recognised. Nurserymen should deal even more drastically with disease than the market grower. If silver-leaf happens to appear, the affected plants should be immediately burnt. It must be recognised that some of the operations carried out in the nursery necessarily entail a risk of infection by wound parasites. Thus in budding and grafting, the exposed tissues may be penetrated by *Stereum purpureum* with the result that silver-leaf disease develops. It is sometimes the practice in budding young nursery stuff to leave a long stub belonging to the stock, to which the developing bud can be tied, thus obviating the necessity of staking. While this practice is almost entirely innocuous with apples, it is fraught with some danger to plums and peaches, especially if these are worked on the 'Brompton' stock which, it is well known, is very susceptible to silver-leaf. It would probably be a sounder practice to cut back the stub, cover the exposed end with grafting wax or with an antiseptic, and tie the developing bud to a stake. That great care is taken generally by nurserymen in eradicating silver-leaf if it happens to appear in the nursery, is evidenced by the fact that it is very rare to see silvering in plum trees under 5 years of age.

Persons who only occasionally grow stocks and work them may perhaps take less care in avoiding disease than the regular nurseryman. Statements have been made that silvered suckers are sometimes taken from diseased plum plantations to be used as stocks, and although reputable nurserymen would not countenance such a practice, provision should certainly be made to prevent the possibility of silvered suckers being used as stocks. If any wide system of nursery inspection is contemplated

in the future, care must be taken, in fairness to the established firms, that those persons who grow stocks for a year or two spasmodically are also subject to its provisions.

There remains to be discussed the best time for carrying out these operations. Whenever a disease is seen, the motto "Do it now" applies with great force to whatever measures may be contemplated. If labour conditions permit, the best time for action on the above lines is during the summer when there is a clear differentiation between healthy and diseased branches. Furthermore, the wounds made by severing branches then have a chance of partly healing before the winter. Action during the early summer is specially important in dealing with silver-leaf, because it is well known that the fructifications of *Stereum purpureum* are produced in greatest abundance on the dead wood during the latter part of the summer and autumn. While pruning and thinning out are taking place during the winter a second opportunity is afforded of dealing with some of the pests which have been briefly mentioned. If, however, labour conditions do not permit of cutting out dead wood during the summer, excision must be left until the autumn and winter.

In large areas of fruit there is a great deal to be said for placing the operations of plant sanitation, spraying, and pruning in the hands of an expert with a gang of men under him. The expert is often anathema to the practical man, but the time seems to have come in large market fruit-gardens, when there is a great deal to be said in favour of a division of labour, the respective portions of the work being in charge of men of special training. In districts where small fruit plantations are the rule, much might be done in the same way by co-operative effort. In the case of the rubber plantations of the East—of which I happen to have some knowledge—there is upon every estate of importance what is known as a pest gang whose sole duty is to watch for and treat disease as soon as it appears. This pest gang is either officered or supervised by a European under whom are one or more intelligent natives who direct the coolies as to what is to be done. In the tropics, sanitary measures of the same kind as those outlined above, are considered of the greatest possible importance, and one of the chief anxieties of the managers of these estates is in seeing that the pest gang is adequately doing its work. Of course most of these rubber estates are much larger than fruit gardens in this country—many of them exceed 1000 acres, but so important is the question of combating disease now considered to be, that some of the largest estates employ a fully trained plant pathologist in an advisory capacity, in addition to the Government staff which is always available. As stated above, there is much



reason in the fruit-growing industry for placing spraying, pruning, and sanitary measures in the hands of a separate labour unit controlled by a man with special knowledge.

Although particular stress has been laid upon certain sanitary measures in controlling some of the diseases that attack fruit plantations, other measures such as winter washing, and grease banding, are of equal importance in diminishing the activities of certain pests, but these subjects have often been dealt with and there is no time for their consideration now. Of primary importance too in the well-being of fruit gardens are adequate drainage, sufficiently wide spacing of the trees to allow of the free circulation of light and air, and reasonably good cultivation of the soil. On the last topic one word may be ventured. It is known that rapidly acting nitrogenous manures induce a succulent type of growth which readily falls a prey to fungoid disease, while on the other hand slow-acting manures such as basic slag and shoddy tend to promote growth in the trees, which rapidly ripens and is less susceptible to parasitic attack.

It may be asked whether the sanitary measures dealt with in this paper are economically sound. The universal test of every commercial operation is the question whether it pays or not. It may be urged that in the long run greater profits will be made where diseases are allowed to run their course in view of the cost of the operations briefly described in this paper. But he would be a bold man to-day who ventured to assert this, and all who have seen plantations of 'Victoria' plums rendered completely derelict by neglect of silver-leaf disease will agree in stating that sanitary measures in fruit gardens are worth while and serve as the best means of insurance for the future. Progressive fruit-growers have long recognised this, but their efforts towards cleanliness in their plantations are sometimes partly discounted by apathy on the part of their neighbours. Those growers, for instance, who neglect silver-leaf disease are a menace not only to themselves, but to their fellow cultivators. The time has come when a person who allows trees killed by silver-leaf disease to remain standing and be the means of propagating the insidious fungus which causes it, will be looked upon as committing a nuisance for which there must be pains and penalties. Public opinion amongst fruit growers, however, can do more good towards introducing proper treatment for the troubles occasioned by disease than all the legislation in the world. It is a pleasure to note that a healthy public opinion in this respect is rapidly developing amongst fruit growers.

With silver-leaf disease, measures of plant sanitation can alone be used at present as a means of control. These measures are simple and easy to carry out, and I am convinced after much

experience of the disease and its treatment, that the disease can be effectively controlled in this way. Silver-leaf and similar troubles are sometimes looked upon as "Acts of God" for which there is no treatment, or else alarm is raised and some nostrum is requested in a hurry which will cause recovery in trees that are already doomed and dying. The cry has been raised that the cultivation of the valuable 'Victoria' plum will be wiped out by the spread of silver-leaf disease. Nothing of the kind—that is, if the measures advocated in this paper are effectively pursued. Where plantations of 'Victoria' plums have been killed by this disease, there has always been terrible neglect, but one hopes that such gardens will soon cease to exist in all the important fruit-growing districts of the country.











